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AUTHOR Aronsson, Karin; And Others
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ABSTRACT

Lexical interference in the recall of adult Finnish/Swedish bilinguals with Finnish dominant is studied. The error patterns of short-term recall of words presented by category in either Swedish or Finnish were examined for translations, lexical substitutions, and intrusions or false recalls of non-occurring words. Individual differences in fluency, education, and task demand were also considered. The results suggest meaningful connections between interference and word category and between interference and fluency as measured by correctly retrieved words. They support bilingual interdependence rather than independence, but do not suggest a unidirectional error pattern (e.g., consistently occurring in the shift from one language to the other). Several tables are included. (MSE)

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FREE RECALL OF MIXED LANGUAGE LISTS. ERROR PATTERNS IN BILINGUAL MEMORY

Karin Aronsson
Anja Metsola
Depatment of Communication Studies

Linkoping University
S-581 83 Linkoping

FL 016 292

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Karin Aronsson, Anja Metsola,
Eero Norrbacka, and Kaisa Tervonen
Department of Communication Studies
Linköping University
S-581 83 Linköping

FREE RECALL OF MIXED LANGUAGE LISTS. ERROR PATTERNS IN BILINGUAL MEMORY

The present work is an exploratory investigation of lexical interference in the recall of nonbalanced bilinguals. Basic research on bilingualism often employs so called balanced bilinguals; speakers with equal mastery of two languages. These bilinguals are often defined in terms of high or superior mastery of both languages. Yet, a very large percentage of real-life bilinguals are nonbalanced bilinguals. This especially holds true in Europe today where a great number of immigrant workers have to interact in their weaker, non-dominant language. Naturally, language dominance is a complicated issue, changing dynamically through a person's life time and also with the types of communication situations concerned. However, for the immigrant worker, nativelike mastery of the second language is but seldom achieved, and in this general respect, the second language can be defined as the weaker one.

Problems of balance and imbalance concern the bilingual speaker directly, also on a subject level. Many superficially fluent bilinguals report more or less pronounced suffering from "language loss", language mixing and problems in retrieving words. These practical problems are closely linked to basic issues in models of bilingual memory, most generally stated to the basic problem of independence or interdependence of first and second language processing. Research on bilingual information processing has convincingly demonstrated interference in the speed and effort associated with bilingual performance, when compared to monolingual performance. Processing time increases when the two languages are simultaneosly activated (Dornic, 1979; Gutiérrez Marsh & Hipple Maki, 1976; Macnamara & Kushnir, 1971). Also, perceived effort has been shown to be greater among subjects in bilingual

than monolingual conditions, even when there are no differences in performance for the two types of conditions (Dornic, 1980). Furthermore, the Dornic study validated subjects' experiences of greater effort in that their performance on a subsidiary task was inferior in the bilingual than in the monolingual condition. Thus, subjects may perform with unimpaired accuracy when they have to simultaneously activate two languages, but at the cost of less spare capacity for other tasks.

Evidently, bilingualism entails a certain price in terms of energy expenditure and loss of speed in verbal processing (cf. Dornic, 1979; Mägiste, 1979a). The cited findings indicate that the two language systems are somehow connected, functionally and/or through common storage. Results on bilingual recall also support this hypothesis. Various studies have indicated interference in bilingual retrieval of words. For one thing, there are transfer effects when subjects learn lists containing translation equivalents of previously rehearsed material (Young & Saegert, 1966; Young & Webber, 1967; Saegert, Kazarian & Young, 1973). Kintsch and Kintsch (1969) have demonstrated slower learning in paired associate learning. Also, Kintsch (1970) found interference in recognition (false recognitions of translation equivalents of the target words). As can be expected, research on mixed language recall (with stimulus words in both languages) shows that subjects more easily remember material from unilingual than bilingual lists, and more easily from bilingual than trilingual lists (Tulving & Colotla, 1970).

In mixed language tasks, subjects generally recall the target words in the appropriate language, and not its translation equivalent (cf, Lambert, Ignatow & Krauthamer, 1968; MacLeod, 1976; Nott & Lambert, 1968; Rose & Carroll, 1974). However, most investigations report occasional translation errors. An inspection of the reported data reveal that these constitute between 1 and 21 % of the number of concept recalls, but typically less than 12 %. Previous work indicates that interference increases as the material becomes more meaningful. First, we find no translation errors in primary memory tasks since these are not conducive to word classification (cf. Kintsch & Kintsch, 1969). Also, memory tasks which employ unrelated sets of words (non-category lists) do not result in translation errors. In contrast, subjects tend to produce translation errors in category tasks (cf. Lambert, Ignatow & Krauthamer, 1968; Nott & Lambert, 1968). It is worth noticing that interference increases with more meaningful material. This

tendency may in fact indicate that laboratory studies underestimate interference in real-life situations (at least in select situations which demand the simultaneous activation of both languages).

Interference and individual differences. Scientific confusion about bilingual confusion

As shown, various results indicate that interference is not a mere epiphenomenon but something that really affects the bilingual speaker (greater perceived effort, lesser speed and spare capacity, interlingual confusion etc). However, we cannot assume that bilingual individuals are uniformly affected. Obviously, language habits, prior acquisition history, and other factors may play a role. If there are such individual differences, they would also have educational and other societal implications (e.g. for optimal construction of bilingual curriculae, for timing of second language introduction etc). For more than a decade, the Lambert group in Canada (Dil, 1972) explored the role of individual differences. Their hypothesis was that the acquisition history of the two languages exerts a considerable influence on the type of bilingual information processing. The basic notion in their research was that so called coordinate bilinguals are more capable of keeping their two languages apart than compound bilinguals are. Originally, compound bilingualism was merely associated with prior learning of the two languages in one single context (e.g. both languages spoken at home by both parents), whereas later, the Lambert group also defined compound bilingualism in terms of early bilingualism, shaped before the bilingual person's formal schooling. In contrast, coordinate bilinguals have been defined as those speakers who have learnt their two languages in two different contexts. According to the latest definition, they are also those bilinguals who have learnt the two languages at different times, L1 before the school début and L2 after school age.

The compound: coordinate distinction is rooted in an associationistic referential theory of language. It is foremost a semantic model of bilingualism. Yet, it does not handle important issues in semantics like polysemy or fuzzy concepts. Also, as can be seen in Dil (1972), the large body of quite ingenious experimentation has failed to reveal any consistent response differences between coordinate and compound bilinguals on various tasks (such as the free

recall of mixed language lists, semantic differentials for the same concepts in the two languages, reaction time measures, and semantic satiation, etc).

The compound: coordinate model has been criticized on several different occasions (e.g. Diller, 1970; Macnamara, 1972). It is now more or less an obsolete construct. However, we still have to handle interindividual differences between individuals with respect to bilingual information processing. Recently, several researchers have increasingly used the distinction between balanced and nonbalanced bilingualism in a fashion, which is somewhat similar to the old conceptualization of coordinate: compound bilingualism. Regrettably, the distinction between balanced and nonbalanced bilingualism is almost as illdefined as its disreputable predecessor.

Theoretically, the notion of balanced bilingualism as such is quite dubious; language skills are not unidimensional, and we may thus find balance and imbalance in the same subject. A bilingual speaker may be "balanced" with respect to phonology but not with respect to syntax. Also, somebody may be quite fluent in certain language domains but not in others, depending on whether he has had extensive contact in one or both languages in the domains of church, school, home, etc (cf. diglossic situations).

In several investigations "balance" is defined not only in terms of equal mastery in two languages, but also in terms of fluency or excellency (e.g. Ben-Zeev, 1977; Mägiste, 1979b). Balanced bilingualism has thus become a composite concept of fluency/excellency on the one hand, and balance on the other. Equal mastery is typically defined by reaction time techniques, and fluency is assessed through self-ratings (e.g. Mägiste, 1979b).

Obviously, this type of classification system will yield various permutations of fluency x balance which are difficult to sort into a balance/nonbalance dichotomy in a reliable fashion. Symptomatically, several studies refer to balanced and nonbalanced bilinguals without any indication of how this problem has been settled. As things now stand, balanced bilingualism seems to be a confounded concept, which refers to fluency and/or balance.

The confused state of the art is reflected in the diverging results for balanced bilingualism on degree of interference, where some studies show more interference among "balanced" bilinguals (Nott & Lambert, 1968), while other studies reveal less interference among balanced bilinguals (Lambert, Ignatow & Krauthamer, 1968). The inconsistent results are not surprising, if we consider the composite character of the definition of "balance".

One determining factor behind some findings is probably degree of automaticity or overlearning, when the two languages are combined. Therefore, it seems important to inspect the combined pattern of L1 and L2 mastery. In the present investigation, combined mastery (fluency) will therefore be related to degree of lexical interference between the two language systems.

Interference and fluency

According to Weinreich (1968) and others, we should find more interference with less mastery. In free recall of mixed word lists, we may thus expect that low automaticity will also be associated with more interference. There are also experimental results which can be taken as support for this position. For instance, Goggin and Wickens (1971) compared degree of interference in a Low and a High group of bilinguals. The Low group was defined in terms of unequal degrees of fluency (low fluency in at least one of the two languages), whereas the High group was defined in terms of equal fluency in the two languages (self-ratings 4-6 on a 1-9 scale; i.e. fairly good fluency). The results showed that there is more interference with less mastery in that release from proactive interference was considerably lower among the Low than High group bilinguals (44% and 98%), which means that the fluent bilinguals were also much better at keeping their two languages apart.

The translation hypothesis and other explanations of functional independence (L1/L2)

In general, results which reveal bilingual interference have been interpreted as support for common storage (rather than separate storage of the two sets of lexical words, L1 and L2). The somewhat paradoxical fact that subjects most of the time are quite able to recall the language of presentation has generally been explained by positing the existence of language tags. These tags contain information about the input language, stored along with the target concepts (cf. Nott & Lambert, 1968; Lopez & Young, 1974; Saegert, Kazarian & Young, 1973).

An alternative model to the common storage model is one of separate storages. Of such models, the one which provides the most plausible explanation of some of the relevant findings is the "translation hypothesis" which has been formulated by Tulving and Colotla (1970). They maintain that there are two separate memories which interact through automatic translation from the weaker into the stronger language. If this model holds, we would mainly find translations in one direction (e.g. from L2 to L1).

Goggin and Wickens (1971) found more translation errors among their less fluent bilinguals and suggested that these results may be due to a tendency of nonfluent bilinguals to translate from the nonpreferred into the dominant language. As can be seen, this interpretation of the results can then be taken as support for the translation hypothesis of Tulving and Colotla (1970). In contrast, Lopez and Young (1974) found that positive transfer occurred both in the stronger to weaker, and in the weaker to stronger condition in a familiarization experiment; i.e. they did not find the differential facilitation that would have been predicted by the translation hypothesis. Macnamara and Kushnir (1971) conducted an experiment which required their subjects to switch between the two languages. They found that the subjects always needed more time when switching between languages than when performing in their weaker language. However, if subjects automatically translate from the weaker to the stronger language, they should *not* perform worse in the mixed than in the weaker language condition (since the translation is already done for them in the mixed condition). Thus, this study does not support the translation hypothesis. Of the research which we have briefly reviewed, the last two studies do not support the hypothesis, whereas the previous ones do (Goggin & Wickens, 1971; Tulving & Colotla, 1970). Thus, the issue is far from settled. There is no conclusive evidence pro or con the translation hypothesis. In the present state, we would clearly benefit from more data on automatic translations in bilingual subjects.

Kolers (1968) maintained that neither common storage nor separate storage can fully account for the research findings in the area. Similarly, Dornic (1979) has argued for some type of common storage but in combination with smaller language specific storage systems. If we temporarily accept this latter model, a corollary question pertains to the nature of the different storage systems. What are the semantic and other determiners of whether words will be stored in language specific and/or in unbound form?

Kolers (1968) reported results showing more interference for concrete terms (like TREE) than for abstract terms (like JUSTICE). His results make sense in that frequent nouns of a concrete type are probably used in more similar ways in the two languages (than more abstract nouns which should be more language bound). Rosch, in her model of basic level organization, maintains that certain words refer to a more basic level of abstraction than others; to a habitual level of abstraction. Thus, CAR is more basic than the subordinate SPORTS CAR and also more basic than the superordinate VEHICLE (Rosch et al, 1976). Analogously to Kolers' results for concrete versus abstract words, we could thus also expect more interference among basic level concepts in the bilingual's two languages (than among the subordinate/superordinate terms).

It was the goal of the present investigation to explore such intralingual factors behind lexical interference as well as interindividual determiners of interference (e.g. degree of fluency). In contrast to many other memory studies, we were therefore *primarily interested in the error patterns in their own* right. The study of the lexical interference requires a corpus of lexical intrusions. Accordingly, we chose instruments which might elicit confusion errors; more specifically mixed language lists of a category type. We chose category type lists, since these are known to elicit more confusion than non-category lists (Nott & Lambert, 1968). Also we deliberately recruited subjects that might differ in degree of automaticity/fluency; Finnish-born workers without grammar school education and students at the university (both groups composed of fluent speakers of their second language, Swedish, in *everyday* interaction).

Method

Subjects

The 44 volunteer subjects were bilingual adults of Finnish extraction (born in Finland and presently living in Sweden; all below 40 years of age). Twentythree subjects work with manual work in Olofström (LM or Volvo), whereas twentyone subjects are students in Lund. All subjects are fluently bilingual in everyday interaction and have at least six years of experience with Swedish; either through Swedish residence or through six years of Swedish as a school language in Finland combined with at least

two years in Sweden. No Finland-Swedish persons or childhood bilinguals were allowed in the sample (which meant that 3 subjects were excluded from an original pool of 47 subjects).

Instruments

Three sets of 40 words were composed for the purpose of the present experiment. After listing sets of 40 words, half the words in each subset were randomly chosen to be translated from Finnish to Swedish. Subsets consisted of different semantic categories, e.g. list I, nouns, consisted of 20 furniture terms and 20 kinship and friendship terms. List II contained nouns referring to household utensils (10), food (10), spatial terms (10) and moral terms (10). List III contained two subsets of verbs; half of which were chosen for their emotional connotation (e.g. KISS, LOVE, HATE). Words were chosen which are fairly frequent, and the different subsets within each list were matched for word frequency. All 120 words were typed on cards.

Procedure

The lists were presented in order I-III. Words within each list were presented in random order, a different order for each subject. The words were presented at a 2-second rate. Each presentation was followed by a written recall test in which subjects were asked to recall as many words as possible. Prior to the first list, it was emphasized that even if subjects could not remember the language in which the word was presented they should still try to recall the word. Also they were instructed not to bother to repair their lists, just to write down the first word that they could recall, and as fast as possible. Two minutes were allowed as retrieval time for each test.

Results

Error analysis

The subjects produced a total number of 1 829 responses, including 1 604 lexical retrievals (correct concepts in the correct language), 153 language substitutions (translation errors; correct concepts), and 72 category intrusions. Subjects recalled about the same number of words in the correct language in both Finnish and Swedish; 806 lexical words in Finnish (L1), and 798 lexical

words in Swedish (L2). In research with bilingual lists, it has been noted in different contexts that the number of correct recalls in each of the two languages does not indicate language dominance in any reliable way. In fact, subjects sometimes recall more words in their weaker language (e.g. MacLeod 1976; Nott & Lambert 1968; Tulving & Colotla, 1970). In the present investigation, there is in fact also a small L2 advantage if we take into account also the number of concepts which are recalled but in the wrong language. There are 93 such translation errors from Swedish to Finnish, but only 60 from Finnish to Swedish. If these errors are added to recall in the correct language (lexical recalls), subjects in fact recalled more words from the Swedish lists; 891 word concepts from the Swedish lists and 866 from the Finnish lists.

The lexical substitutions thus tend to follow the most typical pattern; i.e. translations from the weaker to the stronger language. In all, there are 153 substitutions, and the Swedish to Finnish advantage (93) over the Finnish to Swedish tendency (60) is statistically significant; binomial test, $z = 2.61$, $P < 0.005$. This tendency of more translations from the weaker to the stronger language thus extend the validity of earlier results showing a weak to strong direction in the translations.

There were 72 category intrusions, i.e. false "recalls" of words that had occurred neither in L1 nor in L2. The most common intrusion, 12 cases, was TABLE (Swedish BORD or Finnish PÖYTÄ) and the next common one, 4 cases, was LAMP (Swedish LAMPA or Finnish LAMPPU). Intrusion errors were of the same word class as other words in the target list. The category intrusions were quite evenly distributed among conditions, with no systematic relation to fluency or to type of word category.

If extended to more abstract nouns than those referred to by Rosch et al (1976), certain kinship terms like FATHER should be more basic than more specific terms like GRAND-FATHER (when literally considered as a type of father) and also more basic than general terms like MAN. List I (Table 1) contains basic and non-basic kinship terms, in this extended sense, as well as furniture terms which are in fact offered as illustrations for basic/non-basic terminology by Rosch et al; e.g. CHAIR versus EASY-CHAIR. An inspection of the response patterns revealed that "basic" terms were translated more often than their related terms, $P < 0.019$ (Table 2). Thus, degree of lexical interference is apparently related to level of abstraction in a predictable fashion.

Table 1. Number of substitutions in series I; concrete nouns: furniture and kinship terms.

Stimulus word and language of presentation; Swedish (Sw) or Finnish (Fi)	Number of spontaneous translations
Sw: STOL[6] [1] (chair)	8
Sw: SOFFA[15] (sofa)	5
Sw: BÄNK[7] (bench) BOKHYLLA[22] (bookshelves)	4
Fi: SOHVAPÖYTÄ[7] (sofa table)	4
Sw: MATBORD[10] (dining table)	3
Fi: MATTO[17] (carpet) TAULU[7] (picture)	3
Sw: GUNGSTOL[16] (rocking-chair)	2
BORDSLAMPA[15] (table-lamp)	2
Fi: HYLLY[15] (shelf)	2
Sw: TAKLAMPA[19] (ceiling-lamp)	1
GARDINER[18] (curtains) KUDDE[13] (cushion)	1
Fi: PALLI[18] (stool) SÄNKY[14] (bed)	0
KAAPPI[12] (cupboard) KIRJOITUSPÖYTÄ[9]	0
(writing-desk) PAPERIKORI[7] (waste-paperbasket)	0
NOJATUOLI[11] (lounge chair)	0
Sw: MOR[16] (mother)	7
Fi: ISOÄITI[14] (grand-mother)	6
Fi: ISÄ[25] (father) APPI[12] (father-in-law)	5
Sw: FARFAR[22] (grand-father + paternal)	3
Sw: SVÄRMOR[22] (mother-in-law)	2
Fi: SULHANEN[18] (fiancé) ENO[18] (uncle + maternal)	2
Sw: FASTER[12] (aunt + paternal) VÄN[11] (friend)	1
Fi: TYTÄR[15] (daughter) YSTÄVÄTÄR[12] (friend + female)	1
Sw: KUSIN[22] (cousin) SVÄRDOTTER[15] (daughter-in-law)	0
MAKE[15] (husband) KAMRAT[8] (comrade) FARBROR[7]	0
(uncle + paternal)	0
Fi: MORSIAN[17] (fiancée) POIKA[14] (son)	0
VAIMO[9] (wife)	

[1] The figures indicate number of lexical recalls

Table 2. Basic level and number of substitutions.

Word pair (basic level word to the left)	Is the basic level word translated more often?
MOR : ENO (mother : uncle • maternal)	yes
MOR : ISOÄITI (mother : grandmother)	yes
MOR : SVÄRMOR (mother : mother-in-law)	yes
TYTÄR : SVÄRDOTTER (daughter: daughter-in-law)	yes
ISÄ : APPI (father : father-in-law)	no
ISÄ : FARFAR (father : grandfather • paternal)	yes
ISÄ : FASTER (father : aunt • paternal)	yes
ISÄ : FARBROR (father : uncle • paternal)	yes
HYLLY[1]: BOKHYLLA (shelf : book-shelves)	(no)
STOL : NOJATUOLI (chair : easy-chair)	yes
STOL : GUNGSTOL (chair : rocking-chair)	yes
SOFFA : SOHVAPÖYTÄ (sofa : sofa-table)	yes

Binomial test; N = 12 x = 2 P < .019

[1] It is doubtful whether HYLLY should be considered as a basic level term. However, it is included as it works against the hypothesis.

List II contains four categories of words: spatial terms and terms referring to household utensils, food and moral. Categories were initially chosen as more or less concrete (Table 3). As shown – 8, 6, 9 and 11 substitutions per category – there is no differential error pattern. Similarly, in List III, there is no statistically significant difference between the number of translations between "neutral" and "affective" verbs; 17 versus 22 substitutions (Table 4). According to Kolers (1968), we could have expected a greater number of translations for verbs like KISS, LOVE. Yet, there is no such trend. However, the construction of the present list was fairly crude, and data of this type are most elusive.

Table 3. Number of spontaneous translations in response to series II; concrete nouns (household utensils, food), and abstract nouns.

Stimulus word and language of presentation; Swedish (Sw) or Finnish (Fi)	Number of spontaneous translations
Sw: GAFFEL[21] [1] (fork)	2
Fi: LAUTANEN[13] (plate)	2
Sw: KNIV[18] (knife) GLAS[3] (glass)	1
Sw: KANNA[15] (pot) SKÅL[8] (bowl)	0
Fi: LUSIKKA[17] (spoon) VAASI[13] (vase)	0
KATTILA[9] (sauce-pan) KUPPI[5] (cup)	0
Fi: LIHAPULLAT[13] (meat balls)	4
Sw: KÖTTSOPPA[16] (meat soup)	2
Fi: HERNEKEITTO[21] (pea soup)	2
Sw: PANNKAKA[16] (pancake)	1
Sw: KÅLDOLMAR[24] (stuffed cabbage rolls)	0
PYTTIPANNA[24] (fried diced meat and potatoes)	0
POTATISMOS[11] (mashed potatoes)	0
Fi: VANUKAS[15] (pudding) SILLISALAATTI[7] (herringsallad)	0
PUURO[6] (porridge)	0
Sw: CIRKEL[12] (circle)	2
Fi: LEVEYS[18] (breadth)	2
Sw: KVADRAT[14] (square) TRIANGEL[14] (triangle)	1
AVSTÅND[12] (distance)	1
Fi: PITUUS[19] (length)	1
Sw: RIKTNING[4] (direction)	0
Fi: PAKSUUS[11] (thickness) KOKO[9] (size)	0
SYVYYS[19] (depth)	0
Sw: RÄTT[17] (right)	4
Sw: GODHET[12] (kindness)	3
Sw: BROTT[16] (crime)	1
Fi: EPÄOIKEUDENMUKAISUUS[34] (injustice)	1
Fi: OIKEUDENMUKAISUUS[29] (justice)	1
RANGAISTUS[14] (punishment)	1
Sw: ANSVAR[14] (responsibility) SNÄLLHET[8] (goodness)	0
Fi: VAPAUS[10] (freedom) SYY[8] (blame)	0

[1] The figures indicate number of lexical recalls

Table 4. Number of spontaneous translations in response to series III; verbs.

Stimulus word and language of presentation; Swedish (Sw) or Finnish (Fi)	Number of spontaneous translations
Sw: SKRIVA[41] (write)	6
Sw: TÄNKA[11] (think)	4
Sw: NÅ[29] (reach) SPRINGA[11] (run)	1
RÄCKA[8] (reach) HOPPA[6] (jump)	1
Fi: ISTUA[15] (sit) NÄHDÄ[12] (see) LAULAA[8] (sing)	1
Sw: ROPA[12] (shout) ANDAS[7] (breathe)	0
LUKTA[6] (smell) TÄCKA[8] (cover)	0
Fi: KUUNNELLA[18] (listen) KUULLA[31] (hear)	0
LUKEA[13] (read) MENNÄ[10] (go)	0
KATSOA[6] (look) LÖYTÄÄ[3] (find)	0
KUULOSTAA (sound)	0
Sw: SKRATTA[10] (laugh)	6
Sw: HATA[17] (hate)	5
Fi: ITKEÄ[16] (cry)	4
Fi: INHOTA[19] (detest)	2
Fi: RIIDELLÄ[11] (quarrel)	2
Sw: SMEKA[14] (caress) SKÄMMAS[13] (be ashamed)	1
PITÄÄ[6] (like)	1
Sw: KYSSA[27] (kiss) BESKYLLA[14] (accuse)	0
NJUTA[10] (enjoy oneself) BEUNDRA[11] (admire)	0
MISSTÄNKA[7] (suspect) SNYFTA[3] (sob)	0
Fi: RAKASTAA[31] (love) KIROILLA[9] (swear)	0
KAIVATA[8] (miss) KEHUA[7] (brag)	0
LOHDUTTAA[7] (console) KADEHTIA[5] (envy)	0

[1] The figures indicate number of lexical recalls

Interference and fluency

It was expected that subjects with lesser degrees of fluency should suffer from more lexical interference than subjects with greater fluency. Fluency

was defined in terms of the pooled number of lexical words correctly recalled (counting both L1 and L2 recall). Thus, subjects were split into a high and a low fluency group: 22 subjects at or below 36 lexical words correctly recalled and 22 subjects at or above 37 lexical words, the total range being 14-64 words across all three lists. Semantic interference occurred among most subjects (91%). Degree of interference was determined by the percentage of substitutions out of all words recalled (including translation errors). As expected, subjects in the Low group showed a significantly higher proportion of language substitutions (spontaneous translations) than the High group subjects; $P < 0.001$ (Table 5).

Table 5. Fluency and degree of lexical interference.

Fluency (lexical recall)	Mean percentage substitutions	N = 44
Low (N = 22)	12.05	
High (N = 22)	5.68	
Mann-Whitney U Test ; z = 3.27, one-tailed		P < .001

Thus, degree of lexical interference is greater among those subjects who are less fluent. One possible artifact behind the present results could be that the low performers recall as many concepts as the high performers but only do not retrieve the language tags. In order to check this explanation, total recall (including substitutions) was compared between the low and the high group. The results indicate that the high group performs best even when substitutions are taken into account (Table 6).

Logically, if we are to explain translation errors in terms of compensatory translations from a weaker to a stronger language, we should also find differences between lexical recall in Swedish and lexical recall in Finnish. Within each group, there are no significant differences of this type. The Low group recalls 313 words in L1 and 325 words in L2, while the High group recalls 493 words in L1 and 474 words in L2. Thus, it is difficult to explain the

Table 6. Fluency and total recall including substitions.

Fluency (lexical recall)		Level of total recall including substitutions Low	High	N = 44
Low	(N = 22)	19	3	
High	(N = 22)	4	18	
χ^2 = 17.68		df = 1	P < .001	

present substitution patterns in terms of one way compensatory strategies. As previously indicated, subjects translate more often to L1 than to L2. However, this tendency is more pronounced in the High than in the Low group; 68% of all errors in the High group and 56% of all errors in the Low group.

Can the interference responses be explained as the results of habitual automatic translations from a weaker to a stronger language? If this explanation were valid, translations would work only in one direction; from L2 to L1. This was not the case in the present study. In fact, more than half of our subjects (52%) make translation in both directions, and only 23% conform exclusively to the "weak to strong" pattern; i.e. they produce translations only to L1. Moreover, quite a few subjects (16%) exhibit the reverse pattern; i.e. they only make translations from the stronger to the weaker language. The distribution of the three translation patterns is quite even among the High and the Low group. Obviously, the present results thus do not support the translation hypothesis of Tulving and Colotla.

Fluency, education and task demands

Subjects were deliberately recruited from divergent backgrounds with respect to education. We predicted that formal language habits (associated with more schooling) should result in greater fluency (i.e. greater accessi-

bility to lexical words). A χ^2 -analysis of lexical recall and school background also showed this to be the case, $P < 0.001$ (Table 7).

Table 7. Fluency and formal schooling.

Fluency Level of lexical recall	Workers	Students	N = 44
Low (N = 22)	18	4	
High (N = 22)	5	17	
χ^2 = 12.92	df = 1		P < .001

One of the background factors which defines the Low recall group is thus a lesser degree of formal schooling. For instance, as can be seen, 82 % of the Low group subjects are also workers. An inspection of the number of years spent in Sweden, shows that the median number of years in the Low group is seven years in Sweden, while the median of the High group is two years. On the other hand, the Low group has had less years of Swedish as a school language; a median time of three years as compared to eight years for the High group.

Conclusions

In the present investigation, we found meaningful connections between interference and word-category, on one hand, and between interference and fluency on the other. However, we did not include other measures of fluency than the number of correctly retrieved lexical words. Obviously, if we are to draw more firm conclusions about the relationship between bilingual fluency and interference, we would need more sophisticated measurements of fluency. Yet, the present results do indicate that it may be worthwhile to employ this type of measure. As can be seen, the bilingual performance is meaningfully related to degree of interference. We do not know if those subjects whose

performance is most affected by language intrusions are also those who are most easily disturbed in real life situations. Other studies of bilingual recall have not checked this either. However, it seems quite plausible that we would find positive relations between degree of interference in our free recall situation, and subjects' vulnerability, with respect to language performance in stressful everyday situations.

In this investigation, we found differences between our two groups with respect to the relative number of translation but not with respect to recalls in L1 and L2. The present results thus extend previous findings which have shown that best recall in mixed word lists need not be indicative of which language is the dominant one. The error patterns seem to be more valid indicators of language dominance than the number of lexical words recalled. In the present case, we know that the subjects in general regard themselves as quite poor in Swedish according to self-reports (even though they speak Swedish with apparent fluency. This in turn implies that it is perhaps rather the degree of excellency in L1 which determines "balance", and not some kind of functional equilibrium between the two languages.

The present results support bilingual interdependence rather than independence. The experiment is not designed in such a way that it can be taken as unequivocal support for some specific type of storage system. As has been shown, the word lists yielded more translations from L2 to L1 than the other way round. However, when inspecting individual error patterns, we found that specific individuals often produced both types of errors. The individual error patterns did not show anything which could be taken as support for a unidirectional error pattern ("weak to strong translations"). Less than one fourth of the subjects conformed to the L2 —>L1 pattern, which we would have predicted from the translation model of Tulving and Colotla (1970). Thus, since the results do not validate the translation hypothesis of Tulving and Colotla, which is the most convincing independence model, they indirectly lend support to some type of interdependence system. This interdependence can then be realized through common storage and/or through some type of language switch which is continuously on. Both explanations can account for the mutual influence between the two language systems. As has been pointed out by Domic (1979), interdependence can be structural or functional.

Also, there are intralingual factors which determine degree of interference. The present results indicate that basic level terms are more susceptible to lexical interference than related non-basic terms. This finding is quite suggestive for future work. It would be quite illuminating for the understanding of bilingual memory to further explore if these results hold if cross-validated with other language groups, and with other basic level terms.

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